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DIRECTIONS OF USING TECHNOLOGIES OF MACHINE LEARNING IN THE MILITARY SPHERE

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Annotation. Abstract. Creating the Ukrainian Artificial Intelligence Strategy is undoubtedly a pivotal task, especially for reconnaissance and combat operations. Machine learning technologies are considered, including deep learning for detection, analysis, identification of landmines and multispectral images, missiles and other aircraft, hybrid models that use adaptive coding techniques and neural networks, recognition of spatial images in the spectral range.

Keywords: Artificial intelligence, strategy, deep learning technologies, multispectral images.

НАПРЯМИ ВИКОРИСТАННЯ ТЕХНОЛОГІЙ МАШИННОГО НАВЧАННЯ У ВІЙСЬКОВІЙ СФЕРІ

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Анотація. Створення стратегії розвитку штучного інтелекту для України є беззаперечно важливим завданням сьогодення, особливо для військової сфери під час розвідки та ведення бойових дій. Розглядаються технології машинного навчання, зокрема глибокого навчання для виявлення, аналізу, розпізнавання мін і мультиспектральних образів, ракет та інших літальних апаратів, гібридні моделі, які використовують адаптивну техніку кодування та нейронні мережі, розпізнавання просторових образів в спектральному діапазоні.

Ключові слова. Штучний інтелект, стратегія, технології глибокого навчання, мультиспектральні образи.

Introduction

Nowadays, AI is a growing field with a variety of daily life practical applications and currently active research topics: intelligent software to automate daily routines, for natural language processing and pattern recognition, to make diagnostic decisions in the medical field, etc. Artificial intelligence systems are used to solve problems that are difficult to describe with a formal set of rules – problems that are solved either intuitively or drawing on experience. These are mostly applied tasks. Therefore, the relevance and importance of creating the Ukrainian Artificial Intelligence Strategy is undoubtedly a pivotal task in this day and age.

Special focus should be given to machine learning technologies, in particular deep learning. These technologies enable computers to learn from experience and acquire knowledge of the real world using a hierarchy of many concepts.

This approach mimics the learning process of the human brain and enables computers to model complex concepts. Therefore, within the framework of the present-day computing paradigm, machine learning plays a key role in simulating complex real-world tasks due to the wide range of unstructured data available. This area covers, in particular, the computer vision tasks. Computer

vision made a giant leap forward in object recognition, classification, segmentation and localization. Solving such tasks is crucial for military surveillance and warfare. We believe that this area is a top priority for Ukraine in this day and age.

In the military and defense industry, deep learning may be used to detect, identify, and locate landmines and multispectral imagery [1, 2] of missiles and aircraft (drones). It is characterized by a high-speed data input. We offer an approach to the detection of landmines and multispectral imagery of missiles, which is based on the oscillatory neural resonance method. The approach to the detection of landmines and multispectral imagery of missiles requires a series of inputs coming from a radar to an oscillatory neural network [3, 4] and labeled data output that may serve as an example for system load. Therefore, such network can learn patterns that characterize clusters (obstacles), background noise and targets.

Landmine detection is a growing concern due to the danger to people's lives, and the need to eliminate the consequences of the temporary occupation of Ukraine's territories. However, automated landmine detection systems pose a challenge of automatization based on radar data. Nevertheless, common methods of landmine detection no longer provide the required level of reliability and efficiency in tackling these challanges.

Development of a new approach to the recognition of multispectral images is a high-priority and promising task in terms of increasing the combat effectiveness of the Ukrainian Air Force, in particular for the creation of a qualitatively new type of military equipment – reconnaissance and combat unmanned aerial vehicles, which enable real-time target striking.

In order to accomplish that, it is necessary to solve a non-trivial task of operational object detection. Tackling that challenge hinges on present-day advanced space-exploration tools. Since the amount of incoming operational information is constantly growing, it requires the integration of automated multispectral images processing and analysis techniques. In particular, multispectral images include non-stationary signals emitted by charged heterophase plasma nanoparticles formed as a result of the solid fuel combustion (aluminum oxide) in solid rockets. In order to ensure the highest efficiency (speed of functioning) and the quality of spectral images recognition with a high speed input, it is suggested to develop the architecture of oscillatory neural networks and the algorithm for their learning based on evolutionary methods of modeling and information resonance capable of adapting to real-time dynamic conditions.

Therefore, machine learning technologies may be a disruptive AI technology in Ukraine.

We believe that our state has the necessary scientific potential to create AI-powered technologies with sufficient funding.

The Strategy reflects all these components and puts forward prioritized areas for their development. Integration of artificial intelligence technologies in these areas will be a driver of Ukrainian economy.

Another task under consideration in the national security and defense sector of Ukraine is the applied problem of cryptography, which is associated with an insufficient level of data security due to the fast decryption and side-channel attacks. These attacks aim at the physical implementation of algorithms, since the algorithm is eventually implemented by means of a program that is executed by a processor with a certain configuration.

Therefore, existing cryptographic systems are characterized by insufficient versatility, since they depend on a specific encryption device.

Today, effective data encryption algorithms are hybrid models that use adaptive coding techniques and neural networks. In particular, the synthesis of the neural network and the Advanced Encryption Standard (AES) algorithm [5] and two-stage data encryption, which uses adaptive coding technique and Hopfield neural network [6].

One way to increase key crypto-stability in these hybrid information encryption systems is to synthesize a diagonalized neural network with the Advanced Encryption Standard (Rijndael) algorithm [7] and two-stage data

encryption using neural networks with diagonalized synaptic connections between neurons. These data encryption systems are based on the diagonalization of the matrix of synaptic connection coefficients of the neural network in the basis of input image vectors, which ensures the formation of a new key for each new input image. The proposed approach in the above-mentioned encryption systems provides an ever-changing key when encrypting information, which significantly increases the degree of crypto-stability of the algorithm due to changes in the morphology of synaptic connections, compared to existing encryption algorithms.

In the national security and defense sector, the use of artificial neural networks in spatial image recognition with spectral analysis in the infrared range of the spectrum is no less important. Tackling these problems through the use of artificial intelligence technologies will make it possible to use these results to build night-vision devices, which are necessary in combat vehicles, tanks and unmanned aerial vehicles [8 -10]. In particular, the results of the study of spatial image recognition in the spectral range, which are based on convolutional neural networks [11], may be directly used in the construction of infrared detectors for detecting and recognizing images at night in military equipment.

Deep learning algorithms based on artificial neural networks may be used in artillery sound ranging, which is an integral part of artillery reconnaissance. In particular, to automatically determine the coordinates of a hostile battery using data derived from the sound of its guns firing, as well as to direct artillery fire at a position with known coordinates, determining the locations hit by shelling and mines by the sound of their explosions. The neural network system consists of an oscillatory resonance network located on the server and a set of autonomous sound receivers, that is, sensors located on the ground that are connected by wireless communication channels to the server.

Summary

Currently, in the military sphere, neural networks may be used to recognize multispectral images (landmines, dynamic objects - missiles), encrypt information, create infrared detectors (night vision devices) and artillery reconnaissance. For all these tasks, the issues of automatic data processing through teh use of machine learning technologies and increasing the efficiency of tackling of these problems remain unsolved, that is, reducing the computing resource by building a new class of architecture of artificial neural networks, as well as creating a data transmission system (from sensors to servers with neural networks) through secure communication channels.

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